Dual Axis Controller for Extreme Environments, Phase II Project

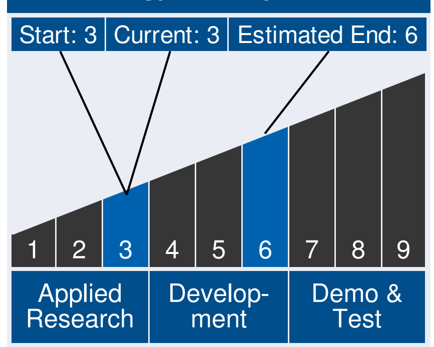
SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

The Dual Axis Controller for Extreme Environments (DACEE) addresses a critical need of NASA's future exploration plans to investigate extreme environments within our solar system. These destinations include asteroids, comets, Phobos and Deimos, Titan, Ganymede, Mars and the Moon. Feasibility of these proposed missions is improved if subsystems can be designed to be more robust in operations and survivability such as to reduce the burden of the overall system and preserve critical resources (i.e. power and mass). In the case of DACEE, the ability to operate a functional electro-mechanical subsystem at temperatures at or below -190C addresses one of NASA's technology hurdles. In Phase 1, a two-axis compact brushless/stepper motion control design was completed with extreme cold operations maintained as the primary design driver. Individual components of the design were evaluated for risk in achieving these goals. The highest risk components were thermally tested. The results of these tests almost completely retired the risk of one component, pending further evaluation, and identified a coherent development path to remedy power regulation needs at extreme temperatures. The objectives of Phase 2 are to deliver a prototype flight-like electromechanical instrument mechanism which includes the fully developed 100 krad tolerant DACEE. This subsystem will have been cryogenically tested and characterized. The motors, gear boxes, and actuated components will be selected by leveraging the best in family for cryogenic operations. The specification of the mechanism will pay close attention to design criteria compatible with achieving significant lifetime actuation cycles based upon appropriate material selections and lubrication approaches. The objective of the Phase 2 activity is to produce a complete instrument mechanism prototype with motion control electronics capable of surviving 100 million revs at the motor.

Table of Contents

Technology Maturity



Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

Program Manager:
- Carlos Torrez

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The applications for the DACEE within NASA's exploration roadmap are numerous. While each investigation has its own unique observational instrumentation needs, the operations contained within those instruments share commonality. For operations which adjust lenses, open covers, pan and tilt, deploy hinges, etc., a stepper or brushless motor control drive capable of delivering between to 1-3 amps @ ~30V covers a broad spectrum of applications. Coupled with the benefits of small form factor and low power means the DACEE can be mounted in or near the instrumentation itself simplifying system level interfacing and control needs. With an expanded operational thermal range the DACEE preserves valuable spacecraft resources by not consuming excess power for heaters or requiring extra mass for radiation protection. The DACEE can operate on weather balloons where temperatures tend to become very cold and challenge typical electronic operational ranges. The DACEE can also be operated in-situ for instruments that may be deployed by future Mars rovers. Again the small size is conducive for space station observatories that need to perform typical scanning and tracking operations.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Outside of NASA's interest, creating a low power, small form factor dual axis controller is very attractive. GEO communication satellites maintain a large number of control interfaces for the ever evolving complicated deployment schemes developed for extending antennas and supporting a variety of hosted payloads. Many satellites include pumps for cooling loops which require similar control needs. Some of the existing control systems are very outdated and the cost of maintaining legacy electronic systems is becoming increasingly expensive. Providing a robust, rad tolerant, low power commercial control

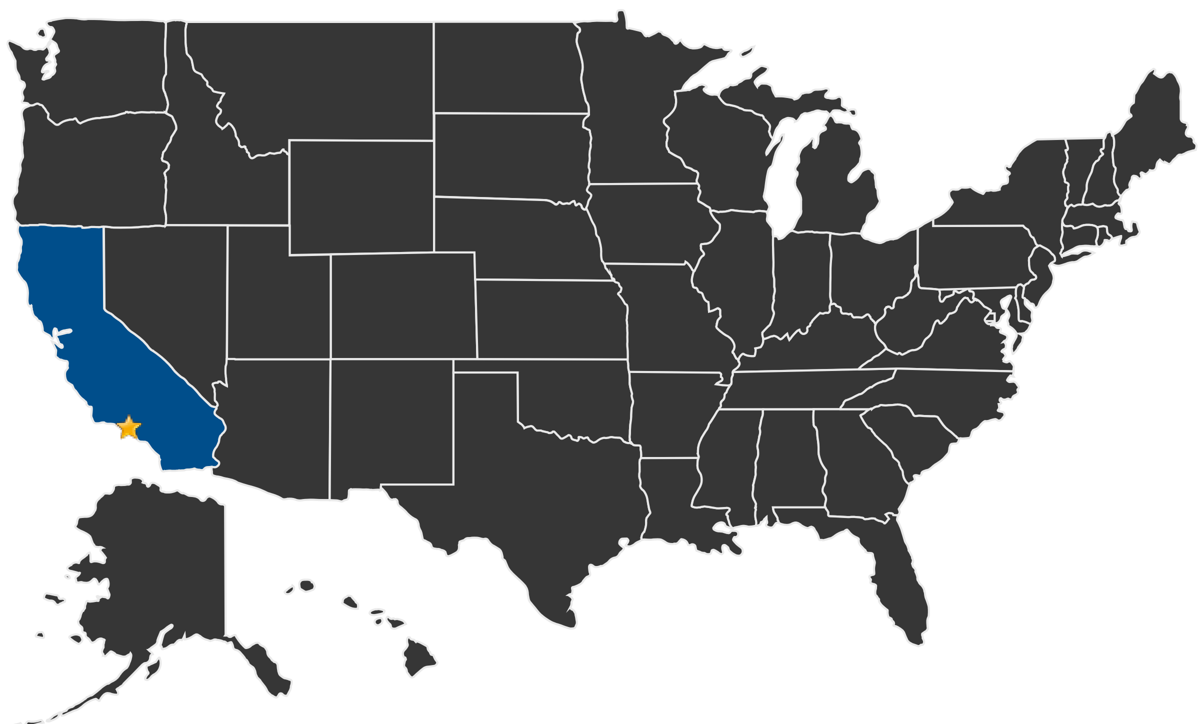
Management Team *(cont.)*

Principal Investigator:

- Greg Levanas

solution based upon the DACEE development could save manufacturers a reasonable amount of cost, power, and mass which could better be allocated for providing additional data services.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Jet Propulsion Laboratory

Other Organizations Performing Work:

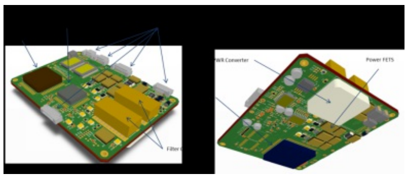
- Motiv Space Systems, Inc. (Pasadena, CA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23371)

IMAGE GALLERY



Dual Axis Controller for Extreme Environments, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

Dual Axis Controller for Extreme Environments, Phase II

Potential Applications

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